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ABSTRACT

Mathematics educators have recognized that although basically a cognitive and intellectual enterprise, learning mathematics is related to children's attitudes toward the subject. Proponents of mathematics reform have emphasized that children need to develop more positive attitudes toward mathematics. A pretest/posttest experimental design study examined the effects of SQUARE ONE TV (SQ1TV), a television series about mathematics aimed at 8- to 12-year-old children, on the problem-solving behavior and attitudes toward mathematics of 240 fifth graders from four public schools in Corpus Christi, Texas. Performance and attitude data were collected from a subgroup of 24 students exposed to 30 SQ1TV programs and from 24 students in a control group having no SQ1TV contact. Reported here are results involving two dimensions of this study, children's motivation to engage with mathematics and their enjoyment of the subject. The implications of the research included the following: (1) motivation and enjoyment were closely related and based largely on arithmetic achievement; (2) children's enjoyment of problem solving focused on the intrinsic aspects of thinking hard and figuring out, rather than on performance concerns; and (3) pretest-posttest change suggest that SQ1TV had a positive impact on children's motivation toward and enjoyment of mathematics. (MDH)

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Children and mathematics:

Enjoyment, motivation, and Square One TV

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Paper presented at the Society for Research in Child Development

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Mathematics educators have long recognized that achievement and performance do not rely on one's knowledge of mathematics alone. The research of Aiken (1970), Fennema and Sherman (1977), and Schoenfeld (1983), among others, has indicated that although learning mathematics is basically a cognitive and intellectual enterprise, real success in mathematics -- a success that will help children into adulthood -- is dependent on children's attitudes toward the subject. Proponents of mathematics reform have also emphasized that children need to develop more positive attitudes toward mathematics.

SQUARE ONE TV (SQ1TV), a half-hour television series about mathematics for 8-12 year-old children, was developed to contribute to the reform movement in mathematics education. The series has three goals, the first of which is "to promote positive attitudes toward, and enthusiasm for, mathematics." SQ1TV attempts to meet its goals by presenting ideas about mathematics and problem solving in an exciting and humorous way. The series presents adults and children using mathematics successfully in various contexts to achieve a wide range of purposes. Additionally, the series encourages children to participate in mathematical activities through engaging content and formats that invite them to actively "play along." The research presented in this paper is drawn from a summative study of SQ1TV designed to measure the extent to which SQ1TV met its first goal, to promote positive attitudes, as well as its second goal, to promote the use and application of problem-solving processes.

When we began our summative study of SQ1TV, we asked the question: what is meant by attitude? In the study of attitudes, many researchers have focused on the role that children's perceptions of the usefulness of mathematics plays in their motivation to pursue the subject. Furthermore, organizations committed to mathematics educational reform, such as the National Council of Teachers of Mathematics (NCTM) and the Mathematical Sciences Education Board of the National Research Council (MSEB) have devised standards for mathematics educators that also emphasize the need for students to recognize the value and utility of mathematics, and to feel capable of using it.

While children's perceptions of the usefulness of mathematics may motivate them to pursue the subject, the research of Dweck and Elliott (1983) suggests that the intrinsic satisfaction and pleasure that one attains from mastering a task, in essence, the enjoyment one derives, is also integral to achievement motivation. Furthermore, a recent study conducted by the American Association of University Women (1990) has indicated that enjoyment of mathematics plays a pivotal role in motivating older children to aspire to occupations that make use of the subject.

In our summative study of SQ1TV, we found that it was critical to explore children's motivation toward and enjoyment of mathematics for two reasons. First, as described in the research above, enjoyment appears to be a factor in children's motivation to further succeed in mathematics. Second, SQ1TV's first goal concerns the promotion of "enthusiasm for" mathematics by showing that "mathematics is beautiful and aesthetically pleasing" (enjoyment) and that "mathematics can be understood [and] used...by non-specialists" (motivation). Not only did we want to explore these two dimensions of attitude and the relationship between them, we wanted to examine whether positive changes in enjoyment and motivation could be brought about by exposure to SQ1TV.

The purpose of this paper is to look at two dimensions of attitude explored in this study, namely children's motivation to engage with mathematics and their enjoyment of the subject.

Background of Study

To examine the extent to which SQ1TV has met its first two goals, we conducted an experimental pretest/posttest study that explored both children's problem-solving behaviors and their attitudes toward mathematics in the absence of any treatment. We then examined whether exposure to SQ1TV affected their problem-solving behaviors and attitudes toward the subject.

The Problem-Solving portion of the study examined the kinds of problem-solving actions and heuristics children used while working on three nonroutine hands-on mathematical

problem-solving activities (which we refer to as PSAs) that varied in their level of complexity. The Attitude portion of the study examined four attitude dimensions aligned with the attitudinal goals of the series: children's beliefs about the usefulness and importance of mathematics, their conceptions about what mathematics is, their motivation to engage with mathematical activities, and their enjoyment of the subject.

Fifth graders in four elementary schools in Corpus Christi, Texas participated in the study. Over an eight-week period, the children in two of the schools (the "viewer group") were shown 30 episodes of SQ1TV while the children in the other schools were not (the "nonviewer group"). This exposure occurred in school, but children's viewing was unassisted; teachers did not comment or elaborate upon the material presented in the series either during viewing or during regular instructional periods.

Forty-eight children (24 from each group), matched for sex, socio-economic status, ethnicity, and performance on a standardized mathematics test, were tested before and after the eight-week viewing period in an experimental pretest/posttest design. One half of the children were boys and one half were girls and the majority of the children selected were Latino so as to mirror the population of the school system as a whole.

Both at the pretest and the posttest, a researcher administered an in-depth Attitude Interview to each child. The interview employed open-ended questions and extensive probing of the children's responses to produce a portrait of children's enjoyment of and motivation toward mathematics, along with two other attitude dimensions explored in the study.

Questions were asked in three domains of mathematical inquiry: the Mathematics Domain, the Figuring Out Domain, and the Problem Solving Domain. The Mathematics Domain focused on what the children identified as "math" and their relationship toward it. The Figuring Out Domain focused on children's discussion of problem solving in general. The Problem Solving Domain explored children's attitudes toward problem solving within the context of the three hands-on, nonroutine, mathematical problem-solving activities that were

administered during the course of testing.

Methods of Analysis

For each attitude dimension, we developed two methods of analysis that would provide detailed information on children's motivation and enjoyment of mathematics both before and after the treatment.

The first, which we call the Descriptive Analysis, was a detailed, categorical analysis that was based upon the range of pretest responses children provided. For the descriptive analysis of enjoyment, we examined what the children enjoyed (or did not enjoy) about mathematics. For the descriptive analysis of motivation, we examined children's conceptions of what "challenge" is. The second analysis, the analysis of the effects of SQ1TV, examined pretest-posttest changes in children's responses using inferential statistics.

Before discussing the effects of SQ1TV on these attitude dimensions, it is important to discuss the results of our descriptive analyses; that is, what children did find enjoyable or not about mathematics and what seemed central to their motivation before any treatment occurred.

Descriptive Analysis of Enjoyment

Although many researchers have discussed whether or not children like mathematics, very little research on attitudes toward mathematics has explored what it is that children specifically like or do not like about mathematics. The dimension of enjoyment, as we define it, is concerned with what the children like or dislike, what they find pleasurable and interesting about mathematics and problem solving, and the reasons they give for their dispositions. Our descriptive analysis of enjoyment describes the kinds of activities that they enjoy and their enjoyment of mathematics and problem solving in general.

Mathematical Activities

To develop a description of what children enjoy about mathematics, we asked: "Can you tell me about a time when you did something in mathematics that you really enjoyed? What was it? What about it did you enjoy?" Only five children, 11%, could not name a task that they enjoyed.

TABLE 1

More than two fifths of the activities that children named involved the computation that they do in the classroom such as multiplication, adding, double-digit divisors, and computational worksheets.

Another two fifths of children mentioned other areas of mathematics, such as fractions, decimals and, at times, less typical aspects of the mathematics curriculum, such as measurement, geometry or symmetry.

The remaining children's responses were less easy to classify within one category. One child spoke of a mathematics trick, finding the "hidden triangles" in a picture. Two others spoke of the enjoyment of teaching others mathematics rather than mathematics itself.

In sum, we found that approximately as many children spoke about computation as spoke about all other areas of mathematics combined. This isn't surprising; in our analysis of children's perceptions of mathematics, computation, was by and large, what the children believed mathematics to be. The reasons the children gave for finding tasks enjoyable suggest different motivational strategies between those who mentioned computation and those who mentioned other areas of mathematics. The children who found computation enjoyable did so because they found it easy and, having mastered the task, felt competent. The children who found other aspects of mathematics enjoyable seem to have done so out of their interest in tasks

themselves (e.g., they were intrigued by the novelty or beauty of the task).

Mathematics in General

To allow children to discuss in more general terms any aspect of their experience with mathematics, we asked them: "Do you usually enjoy doing math? How come?"

TABLE 2

More than two thirds of the children's responses were positive, and less than one third indicated that they did not usually enjoy mathematics. Those children who found mathematics enjoyable gave three reasons for liking mathematics: the sheer enjoyment of learning mathematics, the ease and speed with which they can do mathematics, and certain activities in mathematics that they enjoy. Underlying many of the children's responses was their pride in mastering subject matter. For example, several children explained that they like "getting the answers real quick," or that they like it "'cause I'm getting good grades in math."

The third of the children who said that they disliked mathematics often mentioned that they disliked the repetition and drill involved in the way that mathematics was taught. As one child put it, "It's sometimes boring to learn that same thing again." Others talked about disliking the difficulty in "getting it." They explained that "I don't like to get them wrong" and that it was even "hard to think about it a whole lot."

From this, one can see that children's positive and negative responses presented different perspectives regarding mathematics learning. The children who disliked mathematics seem to be alienated by the repetition within the curriculum as well as the repetition of drill. Children who liked mathematics found learning about numbers and new things to be enjoyable in and of itself. There also was a relationship between children's enjoyment and perceived

difficulty of mathematics in that children who found it difficult also seemed to dislike it, while children who found it easy often liked it.

What Do Children Enjoy About Complex Problem Solving?

As part of our assessment of children's problem-solving behavior, we designed hands-on problem-solving tasks (PSAs) that might be similar to the kinds of problem-solving tasks designed for curricula developed in response to the call for reform in mathematics education. In an attempt to gain some insight into children's enjoyment of complex problem solving, we examined what children found interesting and fun about the most complex problem-solving activity presented to the children in the course of testing. This activity was a mathematical game which was unfair to one player. The children were asked to find out what was wrong with the game and to fix it.

All of the children found the activity to be fun and all but two found the game interesting. The children gave several reasons for their enjoyment of the activity. Many said that they enjoyed the PSA because it was novel, or as several explained, "I liked it because I never did something like that. It was something new." Others said that the game was fun to play with and that they enjoyed manipulating the game pieces. And, finally, several children said that they enjoyed the PSA because it made them "think real hard" or that it was interesting to figure it out.

Descriptive Analysis of Motivation

As will soon be apparent, some of the themes explored in children's enjoyment responses were also salient in children's motivation responses. Motivation refers to factors other than ability that affect the direction, intensity and duration of goal-directed activity. Motivation, as defined in our study, was largely concerned with children's inclination to become involved with tasks, and the persistence and intensity of their involvement.

The concept of challenge was particularly important to our study of motivation since it is central to motivation; that is, one's inclination to seek challenge and expend effort is a sign of high motivation. Furthermore, the term challenge has been important to motivational theories discussed by many researchers. To us, "challenge" meant "pushing one's limits." In our analysis of challenge, we wanted to explore what "challenge" meant to the children.

TABLE 3

The results of our analysis revealed that nearly two thirds of the children understood "challenge" in terms of pushing one's limits either through making a serious effort, mastering something new, or taking on something difficult. Several of these children also described the enjoyment they derived from expending effort.

Nearly one tenth of the children defined challenge as related to performance or competition. These children used challenge to mean striving for good grades, trying to get things right, and beating someone in a competition. For example, when asked to choose which thing they found more challenging, an arithmetic worksheet or the most complex PSA (the mathematical game), all but one who emphasized the demands of performance selected the arithmetic worksheet over the PSA, because, as one child explained, "I get to get a grade for it, and I always try to make 80's and above. It's a challenge for me 'cause I wanna get good grades. 'Cause I'm an honor student. And that's all."

In sum, those children who described challenge as a competition or good grades seemed to rely on external standards as their guide for how well they do. On the other hand, those children who described challenge as "pushing one's limits" often described the intrinsic rewards they gained from engaging with or thinking about the task at hand. This is not to say, of course, that these children did not care about grades or use them as indicators of performance and difficulty; grades may have been important to them, but they did not appear to be central

to their definitions of "challenge."

Certain themes present in the children's definitions of "challenge" appear to be linked to their descriptions of what they find enjoyable about mathematics and problem solving. Just as some of the children define "challenge" to be related to competition and performance, some of the children found mathematics enjoyable because it allowed them to demonstrate their competence and mastery by getting good grades. When children spoke about why they found the complex problem-solving enjoyable, one of their reasons was that these problems gave them a chance to engage with something new. This is evocative of the sense of "challenge" as pushing one's limits. Children's ideas about motivation, as presented in their definitions of the term "challenge," seem to be related to the reasons that they give for finding mathematics and problem solving enjoyable.

Analysis of Effects of SQ1TV

To assess the impact SQ1TV could have on these attitude dimensions, we used two highly detailed coding schemes to determine how different aspects of children's motivation and enjoyment changed after sustained exposure to the series. Overall, results were quite positive and as I proceed, I will present selected highlights of our results. In discussing our results, it will also become apparent how children's enjoyment of mathematics is an integral factor in children's motivation to pursue the subject.

Analysis of Change: Enjoyment

Our analysis of the effects of SQ1TV on children's enjoyment of mathematics and problem solving consisted of two separate analyses: the Reasons for Enjoyment Analysis and the General Enjoyment Analysis.

Reasons for Enjoyment Scheme. The first, which we call the Reasons for Enjoyment analysis, examined children's responses to questions in the Attitude Interview that specifically

asked children about their reasons for enjoying or not enjoying mathematics and problem solving. Children's reasons for enjoyment were categorized into one of four orientations based on their responses: thinker, doer, social, or evaluative.

TABLE 4

Thinker responses indicated that the child derived enjoyment from intellectually engaging in tasks, thinking hard, and solving problems. Doer responses indicated that the child derived enjoyment from actively working "hands-on" with an activity. Social responses indicated that the child derived enjoyment from interacting with others or from ways in which tasks that they discussed were related to "real-life." And, lastly, evaluative responses indicated that children's enjoyment was dependent on meeting standards and expectations of others.

The orientation that appeared to be most in keeping with the goals of SQ1TV was the thinker orientation, and so, our analysis of change focused on the degree to which the children produced thinker responses.

Results. The results of our analysis of children's reasons for enjoyment within the Problem Solving Domain (as reflected in the PSAs administered to them in the study) revealed a marginal difference between the viewer and nonviewer group in the degree to which their enjoyment was derived from thinking, that is, their intellectual involvement with the tasks. When the variance accounted for by the children's sex and ethnicity was controlled for statistically, this difference became significant. Nonviewers declined significantly in the degree to which they spoke about enjoyment in this way and, in the posttest, viewers spoke about deriving enjoyment from thinking significantly more than nonviewers did.

FIGURE 1

These results are encouraging. As I mentioned earlier, the thinker orientation is closely related to the way that mathematics is shown on SQ1TV. The fact that more viewers than nonviewers said that they derived their enjoyment from thinking when asked about the problem-solving activities indicates that the children derived enjoyment from the process of problem solving itself.

General Enjoyment Scheme. The second analysis, which we call the General Enjoyment Analysis, captured unsolicited, spontaneous, enjoyment responses children made throughout the entire Attitude Interview (i.e., without being asked directly about enjoyment). Statements were coded as reflecting either positive or negative affect; that is, we determined whether children felt positively or negatively about any mathematics activity under discussion. Positive statements indicated that they liked or were excited about a mathematical activity, while negative statements indicated that they disliked it or found it boring.

Results. The results of this analysis revealed that viewers showed significantly greater gains than nonviewers in the number of times they spontaneously talked about enjoying mathematics and problem solving throughout the interview.

FIGURE 2

These statements generally indicated pleasure, interest, or positive feelings about a variety of mathematical tasks under discussion.

These results are also encouraging. As you may recall, this measure tallied the children's expression of interest and pleasure that arose without an interviewers direct request for such information. Thus, these spontaneous responses may be a more accurate reflection of what the children actually felt than the valence score taken from the questions specifically targeted for Enjoyment.

Analysis of Change: Motivation

To examine the effects of SQ1TV on children's motivation, we also conducted two analyses: The Motivation Analysis and the Choices and Challenge Analysis.

Motivation Analysis Scheme. In the first analysis, which we call the Motivation Analysis, we looked at the children's responses to specially designed questions within the Attitude Interview that targeted their willingness to pursue mathematical activities and their involvement with those activities. Responses to these questions were classified under one of two orientations toward motivation, namely, engagement and performance. These orientations were similar to the learning and performance achievement goals described in the research literature by Carol Dweck (1983); in fact, the correlation between our orientations and Dweck's achievement goals was highly significant ($r = .47$; $p < .001$).

TABLE 5

Engagement statements were process-oriented statements that indicated that the child was intrinsically motivated by the involvement with the activity itself and concerned with the expenditure of effort in order to learn. They also indicated that the child valued being challenged by situations that allowed him/her to figure something out and develop competence, and found expending the effort to be fun. For example, an engagement statement sounded like this:

> "...What I did was real fun even though it was kind of a -- a thinking project. I still like to think a lot and when I think a lot I think I learn a whole bunch more and kinda forget a little but I could easily gain that little I forgot and then I could ah remember stuff about what I learned."

Performance statements indicated that the child was extrinsically motivated by the outcome of an activity, particularly in terms of the accomplishment and the rewards from parents and teachers that often accompany it. These responses also expressed that the child's willingness to engage in an activity was based upon the child's perception of his or her ability to do it. Low

tolerance for uncertainty and frustration was also often central to these responses. For example, the following child's response was considered to be performance oriented:

> "It's like, 'Oh, I'm gonna be able to get it. Because it's gonna be easy to me um it might be hard to y'all but it's gonna be easy to me..."

These statements were also analyzed for valence, that is, the degree to which the children were motivated to pursue or avoid the mathematical activities discussed in course of the Attitude Interview.

Results. The results of our analysis of orientation revealed that significantly more viewers than nonviewers adopted an engagement orientation rather than a performance orientation (in which the main concern is getting the right answer or getting rewards for being right).

FIGURE 3

These children who exhibited an engagement orientation gave reasons for being motivated or not that focused on engagement with mathematics and problem solving for the sake of learning and the process of figuring out. Interestingly, these reasons for motivation are similar to the ones given by those children who adopted a thinker orientation in enjoyment.

A marginal difference was also observed with regard to the degree to which children were motivated to pursue or avoid mathematical activities discussed in the interview.

FIGURE 4

Both viewers and nonviewers tended to pursue such activities in the pretest. However, while nonviewers were significantly less likely to want to pursue such activities in the posttest, viewers maintained the same level of motivation they had shown previously.

Choices and Challenge Analysis Scheme. To complement the Motivation Analysis, we

conducted a second analysis, which we call the Choices and Challenge Analysis. This analysis targeted two sets of forced-choice questions: 1) which of the three problem-solving activities that were administered to them would they like to try again and, 2) whether they would prefer to work on another problem like the most complex PSA (i.e., the mathematical game) or an arithmetic worksheet containing division problems.

Results. Given the effects observed for orientation, one would also expect that viewers would be more motivated than nonviewers to pursue complex problem-solving tasks. In fact, this turned out to be the case. Significantly more viewers than nonviewers said that they would want to pursue the tasks that were objectively the most complex and difficult and that they subjectively considered to be the most challenging.

Consistently throughout these results, we hear echoes of enjoyment present in both the engagement orientation in motivation and their children's reasons for selecting challenging tasks. The engagement orientation itself has a basis in enjoyment: one of the ways that the children indicated that they were engaged with a task was to speak about their enjoyment of it. Also, many children who expressed an engagement orientation to mathematics and problem solving said that they were engaged for the sake of learning or figuring out. This is remarkably consistent with the reasons given by the children whose responses we categorized as "thinker" in the enjoyment analyses. In the analyses of children's choices of challenging tasks, the children explained that they preferred tasks that required thinking and figuring out which, again, evokes the "thinker" enjoyment orientation. These two dimensions of attitude appear to be conceptually related.

Discussion and Implications

Overall, our findings at the pretest and the posttest suggest that motivation and enjoyment are closely related. In our descriptive analyses, we learned that children's enjoyment of and motivation toward mathematics was largely based upon their experience with arithmetic in school. With respect to enjoyment, many of the children indicated that they enjoyed mathematics because it is fun to learn and think about, it is easy (they are able to do it quickly and successfully) and it involves particular activities (e.g., computation) that they find pleasurable. Those who said they did not like mathematics focused primarily on the difficulty of the subject and the repetition inherent in both the curriculum and the drill and practice methods used to teach it. It appears then, that certain children liked or disliked mathematics for precisely the same reasons -- that classroom activities focused on arithmetic and was associated directly with performance demands such as ease, speed, and accuracy.

These patterns with regard to enjoyment were echoed in motivation. Although some children found the process of learning computational skills and the thinking involved to be motivating factors, it appeared that performance demands related to good grades and speed and accuracy played a fairly central role with respect to children's reasons for their motivation toward mathematics.

Interestingly, children's discussions of their enjoyment of problem solving focused upon intrinsic aspects of the problem-solving process, that is, the process of thinking hard and figuring out, rather than performance concerns. Their reactions to the problem-solving tasks that they worked with over the course of the interview seemed to be tied to engagement with the problem at hand rather than extrinsic rewards (e.g., good grades) or demands of the situation. The parallels with the engagement orientation in motivation are obvious.

Our analyses of pretest-posttest change suggest that the lively presentation of mathematical problem solving on SQ1TV had a positive impact on the children's motivation

toward and enjoyment of the subject. With respect to motivation, viewers' motivation became more focused on engagement with the process of working through mathematical problems that they found enjoyable and challenging rather than by performance concerns, such as "getting good grades." Significantly more viewers than nonviewers also elected to pursue complex mathematical problem-solving tasks over easier and more routine ones. Mirroring these changes in motivation, viewers' enjoyment became more focused on thinking and figuring out. In addition, viewers made a greater number of spontaneous positive enjoyment statements with respect to mathematical activities discussed throughout the entire interview. Overall, it appears that exposure to the series resulted in the children coming to see mathematics as more engaging. [shol - why would it?] This does not mean that children wanted problems to be easy or merely entertaining. The children in this sample were very clear in saying that they enjoyed thinking hard and struggling with difficult problems when those problems were interesting to them.

These findings carry two sets of implications for future research: one related to the study of the development of attitudes toward mathematics generally, and the other related to the study of the effects of SQUARE ONE TV upon those attitudes.

One implication for research on attitudes stems from the close relationship we observed between children's motivation toward pursuing mathematics and their enjoyment of the subject. A number of children in this sample cited enjoyment of mathematics as a reason for their motivation. It is interesting to note that Armstrong and Price's (1982) research with adolescents has suggested that children's perceptions of the usefulness of mathematics are better predictors of their motivation to continue enrollment in mathematics classes than their enjoyment of mathematics is. The source of discrepancy between Armstrong and Price's results and our findings is not clear; perhaps it is due to the different measures used in the two studies, or perhaps this points to a developmental difference between the adolescents studied by Armstrong and Price and the fifth graders who participated in the study.

Indeed, a closer investigation as to how these attitudes develop over time is warranted. Once a detailed picture of older subjects' motivation and enjoyment is available, an in-depth comparison might be made to the results of this study and a clearer understanding of the role these two attitudes play in mathematics achievement will ensue.

Our analyses of change also hold implications for future research regarding the effects of SQ1TV on children's attitudes. First, because subjects were tested only twice in this study (once at the pretest and once at the posttest), it is not clear whether a full 30 programs was truly required to produce observed effects. A study in which subjects were tested several times over the course of the treatment period would be of great help in determining the amount of exposure that is necessary to have positive impact.

Second, it must be remembered that, although viewers watched SQ1TV in school, their teachers were instructed not to incorporate material from the series into their lessons or even to comment on the series in any way. It would be valuable to investigate the potential impact of exposure to SQ1TV when viewing is not unaided -- that is, when teachers incorporate the series into a broader context of instruction, or when parents and caregivers elaborate upon the series in settings outside the classroom.

Whatever the results of future research, though, the message of this study is clear. Sustained exposure to the series can have a significant positive impact upon several aspects of children's motivation toward mathematics and their enjoyment of the subject. Given these results, it appears that SQ1TV can play a significant role in the effort toward reform.

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TABLE 1

QUESTION 55: Can you tell me about a time where you did something in math that you really enjoyed? What was it? What about it did you enjoy?

Distribution of Responses
N=47

Computation:	43%	(20)
Other Areas of Mathematics:	40%	(19)
Miscellaneous:	6%	(3)
Non-Responses:	11%	(5)

TABLE 2

QUESTION 56: Do you usually enjoy doing math? How come?

Distribution of Responses
N=46

Positive:	70%	(32)	Negative:	30%	(14)
Enjoy Learning:	24%	(11)	Repetition:	17%	(8)
Fast/Easy:	20%	(9)	Difficulty:	9%	(4)
Doing Tasks:	7%	(3)	Other:	2%	(1)
Other:	4%	(2)	Non-Responses:*	2%	(1)
Non-Responses:*	15%	(7)			

TABLE 3

QUESTION 34: Which one [of the three PSAs] would you say was the most challenging to you?

QUESTION 64: Which would be more of a challenge for you [PSA C* or this arithmetic worksheet]? Why?

Distribution of Responses[1,2]
Q34: N=95; Q64: N=86
Total N=181

Effort:	19% (34)
Task:	19% (35)
Mastery:	13% (23)
Difficulty:	13% (23)
Performance/Competition:	9% (16)
Miscellaneous:	7% (12)
Non-Responses:	21% (38)

TABLE 4

REASONS FOR ENJOYMENT ANALYSIS

ENJOYMENT ORIENTATIONS

THINKER:	FIGURING OUT, THINKING
DOER:	WORKING "HANDS-ON"
SOCIAL:	INTERACTING WITH OTHERS; "REAL-LIFE" ASPECTS
EVALUATIVE:	MEETING STANDARDS AND EXPECTATIONS

TABLE 5

MOTIVATION ANALYSIS

MOTIVATION ORIENTATIONS

ENGAGEMENT:	**INTRINSIC MOTIVATION BASED ON INVOLVEMENT WITH PROCESS**
PERFORMANCE:	**EXTRINSIC MOTIVATION BASED ON REWARDS FROM OTHERS**

FIGURE 1

Mean proportion of thinker statements ± 1 SD

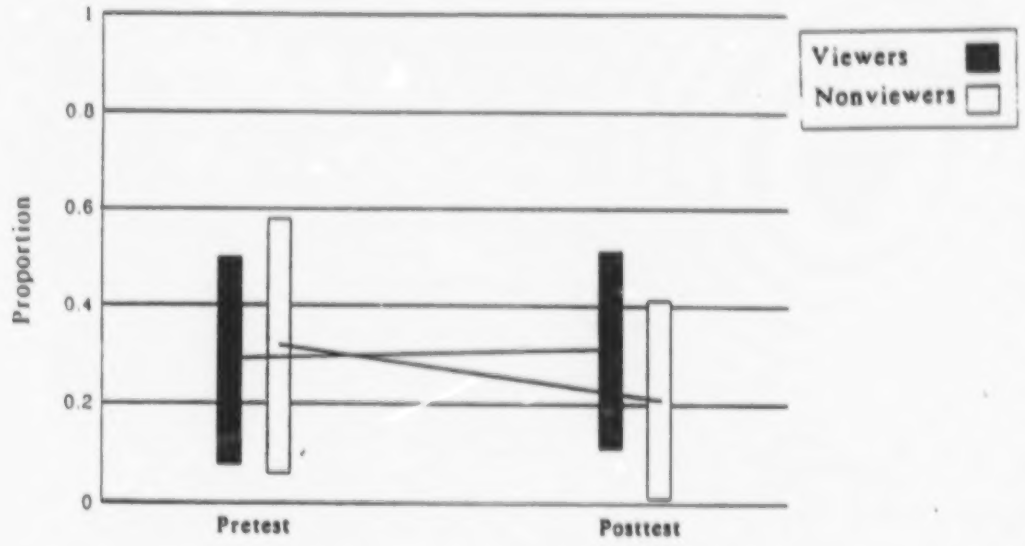

FIGURE 2

Mean number of spontaneous positive statements ± 1 SD

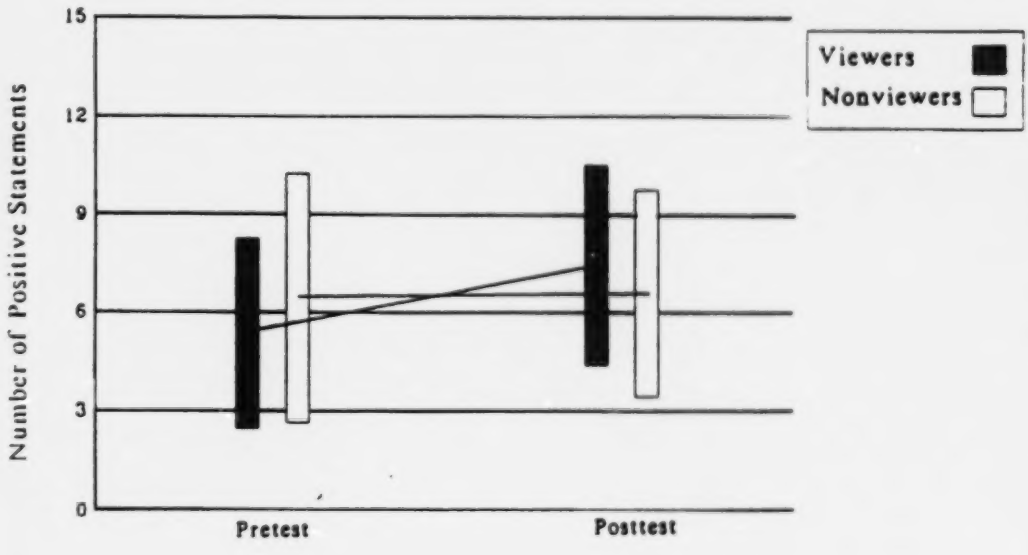

FIGURE 3

Mean proportion of engagement statements ± 1 SD

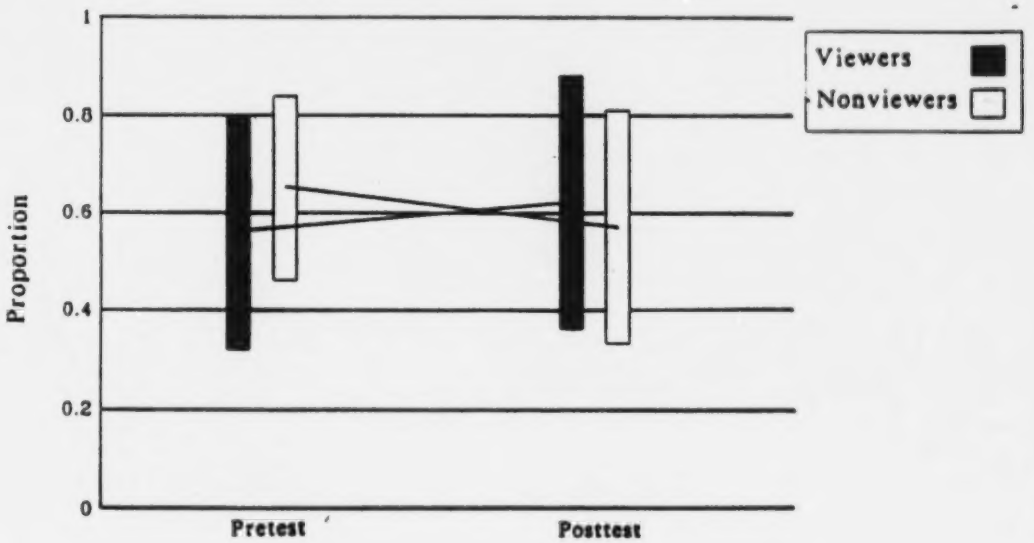

FIGURE 4

Mean proportion of positive statements ± 1 SD